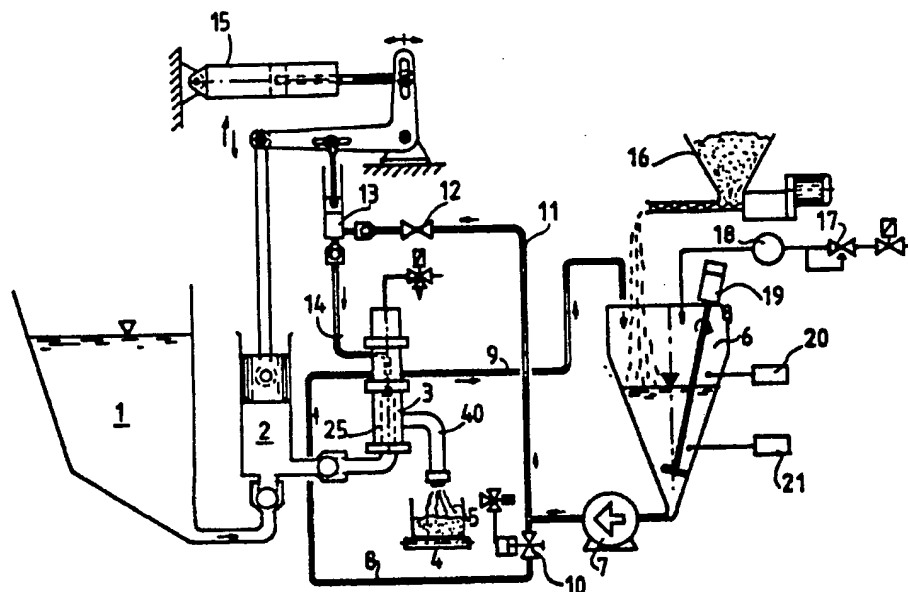




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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**(54) Title:** MIXING ARRANGEMENT FOR RAPIDLY SETTLING SLURRIES



**(57) Abstract**

An arrangement for addition of a certain amount of a rapidly settling suspension to a fluid comprises a circulation path (8, 9) in which a rapidly settling suspension is circulating. A mixing device (3) is connected to the circulation path which device is also connected to a conduit (25) for the fluid to which the suspension shall be added. A supply pipeline (11, 14) for the rapidly settling suspension is connected both to the circulation path and to the mixing device (3). A dosing means (13) for the suspension is arranged in the supply pipeline (11, 14).

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Mixing arrangement for rapidly settling slurries.

The present invention relates to an arrangement for addition of a certain amount of a rapidly settling suspension to a fluid.

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Addition of a predetermined amount of a sparingly soluble substance suspended in a liquid has as far as we know hitherto not been done automatically in continuous processes. The sparingly soluble substance may be suspended in the liquid and hindered to settle for example by a good mixing of the liquid. If thickening means may be used these may hinder settling. If this is not the case problems may arise when the mixture of liquid and rapidly settling substance is to be transported to the spot where addition shall take place. If one for example must stop the process there is a large risk that the suspension settles in pipelines, pumps and valves and these may completely or partly stop up. A partial stop may, when the process starts again, result in that in the first moments only liquid is added after which follows a phase when dislodged settled lumps give a strongly increased concentration of suspended particles. The mixture of fluid and suspension which is obtained under such periods may be completely unfit for its purpose.

Such a process where a rapidly settling substance shall be added to fluid is the production of cheese from soy milk, so called "tofu". In this process a concentrated soy base is produced and to the soy base a predetermined amount of a coagulant, e.g. calcium sulphate is added suspended in water.

According to the invention there is now proposed an arrangement which makes it possible to add a rapidly settling suspension to a fluid, which arrangement is designed such that the problems mentioned above may be avoided. The arrangement according to the invention is mainly characterized in that it comprises a circulation path, in which a rapidly settling suspension is brought



to circulate and a mixing device connected to the circulation path. This mixing device is also connected to a conduit for the fluid to which the suspension is to be added. In the arrangement there is also a pipeline for addition of the rapidly settling suspension, which pipeline is connected to the circulation path and to the mixing device. A dosing device for suspension is located in the feed conduit.

The arrangement according to the invention is with advantage provided with a dosing means for fluid arranged to work synchronous with the dosing device for the suspension. Predetermined amounts of fluid and suspension may be fed to the mixing device by using such an arrangement.

The mixing device consists with advantage of a valve which is used to open and close the connection between the suspension supply pipeline and the conduit through which the fluid flows. This valve has also a constantly open connection through which the suspension circulates. By designing the valve in this way the suspension may be kept in movement all the time.

The valve may with advantage be designed such that in its closed position a communication is formed between the suspension supply pipeline and the connection through the valve in which the suspension circulates. With such a design of the valve the advantage is also obtained that the supply conduit is not closed at any time but the suspension is kept in movement in the same all the time.

The described device is with advantage designed such that the supply conduit for fluid in the valve is formed such that the fluid is at first brought to flow towards the cone of the valve and in the close proximity of the same is brought to turn and at an increased speed be brought in contact with the suspension at which a good mixing is obtained.

In order to make the dosing device for the suspension to work satisfactorily a counter pressure valve is with advantage arranged in the pipeline for suspension, which valve opens when the dosing device for the suspension works.

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According to the invention there is also in the circulation path for the suspension a container in which the powder which shall be suspended in liquid is mixed with the liquid, which container is provided with level guards to be used to control the level and to hinder dry pumping.

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When the arrangement is to be used to mix a suspension and a fluid which are later to be packaged a packing device is suitably arranged in connection to the mixing valve.

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In such a case the dosing device for the suspension and the dosing device for fluid advantageously consist of piston or membrane pumps which work synchronously with the packing device.

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The arrangement according to the invention is described further with reference to the attached drawings, which in fig. 1 show a flow chart of an arrangement chosen as an example only for producing cheese from soy milk, so called "tofu", and in fig. 2 and 3 show an embodiment of the mixing device in a closed and an open position.

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In fig. 1 there is shown a container 1 for the fluid, in this case a concentrated soy milk (soy base), which by means of a piston pump 2 is transported to a mixing device 3. In the mixing device the soy base is mixed with a coagulant, in this case a suspension of calcium sulphate in water, and is transported to a packing line 4 for packages 5. When the soy base is mixed with calcium sulphate the soy base coagulates very rapidly and a firm cheese curd is obtained.

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The coagulant is produced in a container 6. From this a pump 7 feeds the coagulant to a circulation path comprising pipes 8 and 9. In the circulation path there is also a valve 10, a mixing device 3 and a container 6. In this circulation path the coagulant is pumped around all the time in order to be kept in movement to hinder settling and stop in the pipeline.

A pipeline 11 for addition of coagulant is connected to the circulation path. In this pipeline there is a counter pressure valve 12 and a dosing pump 13 of piston type. The dosing pump 13 is by way of a pipeline 14 connected to the mixing device 3. The pumps 2 and 13 work synchronously. The adjustment of the amount of each piston stroke may be made in a known manner for example by adjustment of the long holes on the level arms. For pump 2 this adjustment takes place at the attachment of the piston rod of the driving cylinder 15 and for the pump 13 a similar adjustment of the long hole may be done. In this way the relation between the dosages may be maintained automatically, when an adjustment of the necessary amount for the used packages is made by means of the pump 2.

As it is said earlier the coagulant is produced from powder and water in the container 6. By means of a screw feeder 16, the rotation speed of which may be adjusted, powder is added to the container 6. The amount of water added is controlled by means of the flow meter 17. The added amount is measured by a flow meter 18. In order to obtain a good mixing and to hinder settling, there is a mixing means 19 in the container.

It is desirable that the volume of the mixed suspension should be as low as possible since the active qualities of the coagulant (suspension) is rapidly destroyed after the mixing. The container is therefore provided with two level transmitters 20 and 21, which are connected to the powder feeder 16 and the flow meter 17.

The mixing device 3 is described further with reference to fig. 2 and 3. In these the valve which constitutes the mixing device is shown in an open and a closed position.

- 5 The valve which is shown in fig. 2 has a housing 22 with a valve body 23 and a valve stem 24. An inlet conduit 25 for the main product, soy milk, is provided in the lower part of the valve. Coaxially with and outside of the inlet conduit 25 there is a mixing house 26. The position of the valve stem is controlled by means of an air piston 27 in an air cylinder 28 in  
10 the upper part of the valve. By way of an opening 29 a source for overpressure is connected to a space 30 above the air piston 27. When overpressure prevails in the space 30 the valve is open and when the connection with the source for overpressure is  
15 broken a spring 30 returns the valve stem 24 to the position in which the valve is closed.

- The valve 3 is also provided with an inlet conduit 32 connected to the pipe 8 in the circulation path for the suspension and an  
20 outlet pipe 33 connected to the pipe 9 in the circulation path. A pipe 34 connects the valve with the supply pipe 14 for suspension. In the valve body 23 there is a circular slot 35 through which suspension may flow from the inlet pipe 32 to the outlet pipe 33 in the open position of the valve. In the valve housing  
25 22 there is an annular cavity 36 outside radial channels 37 in towards a space 38 between the valve body 23 and the valve stem 24.

- In order to make it possible to clean the slot between the  
30 mixing space 25 and the inlet pipe 26 there are some small dishing holes 39 in the inlet pipe. The small flow streaming therethrough is remixed at the outlet pipe and does not have any influence on the uniformity of the mixing.

The arrangement according to the drawing is used in the following way when producing packed soy milk cheese.

In the container 1 there is a concentrated soy milk (soy base).  
5 From this, predetermined amounts of soy milk are dosed by means of a piston pump 2 to the mixing device (valve) 3. The soy milk flows in through the inlet conduit 25 (fig. 2 and 3) and up towards the upper part of the inlet conduit. Here the flow is forced to turn and it is forced out from the mixing house under  
10 an increase in speed and out through a pipe 40 arranged in connection with a packing line 4 for packages 5.

The coagulant is produced in the container 6 from a mix of calcium sulphate and water. Calcium sulphate is sparingly  
15 soluble in water and settles rapidly if there is no mixing. The mixing device 19 assures that calcium sulphate is suspended in the container 6.

The suspension of calcium sulphate (in the future called the  
20 suspension) is transported by means of a pump 7 from the container 6 to a pipeline 11. In this there is a counter pressure valve 12 and another piston pump 13. The piston pump 13 feeds a predetermined amount of suspension to the inlet 34 of the mixing valve 3 by way of a pipe 14. The suspension flows  
25 into the valve 3 and flows by way of the space 38 which surrounds the valve stem 23 out from the mixing house 25. The suspension meets the soy milk, then the flow direction of the same is reversed and good turbulence and consequently good mixing of the two liquids is obtained. Immediately  
30 after the mixing the mixture of liquids is filled into packages and coagulation to a firm consistence takes place very rapidly.

The pump 7 also feeds suspension through a circulation path. In this there is a valve 10 arranged in a pipe 8. The pipe 8 is  
35 also connected to the mixing valve 3 by way of an inlet 32 and



an outlet 33. The outlet 33 directs the suspension back to the container 6 by way of pipe 9. When the valve 3 is open, that is when suspension is mixed with soy milk, the suspension is directed from the circulation path through the annular cavity 38 in the valve body 23. In this way the suspension is kept in movement all the time and sedimentation is hindered. When the valve 10 is open the most part of the suspension flows through the pipes 8 and 9 during operation. The pressure in pipe 11 is then so low that the counter pressure valve 12 does not open. Only when the piston in the piston pump 13 moves the valve 12 opens to let through suspension.

If it for some reason is necessary to stop the continuously working arrangement, e.g. depending upon problems with the packaging device, the valve 10 is closed automatically after a signal from a control device (not shown) and the valve stem 24 is drawn upwards by the spring 31 and closes the mixing device 3. The pressure from pump 7 then increases the pressure in the pipeline 11 and a counter pressure valve 12 is forced to open. The non-return valves of the piston pump 13 are arranged in such a way that they do not give any resistance and its valve bodies are lifted such that the passage through the pipe 14 may take place unhindered. In the closed position of the mixing valve the space 38 around the valve stem 24 communicates with the outlet 33 in the circulation path and suspension may accordingly flow back to the container 6.

The valve 10 may be kept in a position where a small through flow opening through the valve is kept open, at which a smaller flow is allowed to pass the circulation path 8, the mixing valve 3 and the pipe 9. The flow which has passed the pump 13 and the mixing valve 3 is also transported to the pipe 9. In this way both settling and blocking of both the pipes 8, 9 and 11 and the pump 13 and the mixing valve 3 is hindered.

Within the scope of the invention a mixing device for rapidly settling suspension may be designed in many separate ways depending upon the intended application.

Claims

1. Arrangement for addition of a certain amount of a rapidly settling suspension to a fluid, characterized in that it comprises a circulation path (8, 9), in which a rapidly settling suspension is brought to circulate, a mixing device (3) connected to the circulation path, which mixing device (3) also is connected to a conduit (25) for the fluid to which the suspension is to be added and a supply pipeline (11, 14) for the rapidly settling suspension connected both to the circulation path (8, 9) and the mixing device and a dosing means (13) for the suspension arranged in the supply pipeline (11, 14).
2. Arrangement according to claim 1, characterized in that it comprises a dosing means (2) for fluid arranged to work synchronously with the dosing means (13) for suspension.
3. Arrangement according to claim 1 or 2, characterized in that the mixing device (3) comprises a valve intended to open and close the connection between the supply pipeline (11, 14) for suspension and a conduit (25) through which the fluid flows, which valve also has a constantly open connection (32, 33, 35) through which the suspension may circulate.
4. Arrangement according to claim 3, characterized in that the valve is designed in such a way that in the closed position of the valve a communication is formed between the supply pipeline (14) for suspension and the connection (32, 33, 35) through the valve through which the suspension circulates.

5. Arrangement according to claim 4, c h a r a c t e r -  
i z e d i n that a supply conduit (25) for fluid in the  
valve is designed such that the fluid is brought to flow towards  
the beam of the valve stem (24) in order to be forced to reverse  
5 in its proximity and with an increased rate is brought into  
contact with the suspension, at which a good mixing is  
obtained.

6. Arrangement according to any of the preceding claims,  
10 c h a r a c t e r i z e d i n that a counter pressure valve  
(12) is arranged in the supply pipeline (11, 14) for suspension,  
which valve (12) opens when the dosing means (13) for suspension  
works.

15 7. Arrangement according to any of the preceding claims,  
c h a r a c t e r i z e d i n that in the circulation path  
(8, 9) for suspension there is a container (6) in which the  
powder which is to be suspended in liquid is mixed with a  
liquid, which container is provided with level guards (20, 21)  
20 to be used to control the level and to hinder dry pumping.

8. Arrangement according to claim 5, c h a r a c t e r -  
i z e d i n that a packaging device (4, 5) is arranged in  
connection to the mixing valve (3) for packaging of the mixture  
25 of fluid and suspension.

9. Arrangement according to claim 8, c h a r a c t e r -  
i z e d i n that the dosing means (13) for suspension and  
the dosing means (2) for fluid constitute piston pumps or  
30 membrane pumps which work synchronously with the packaging  
device.

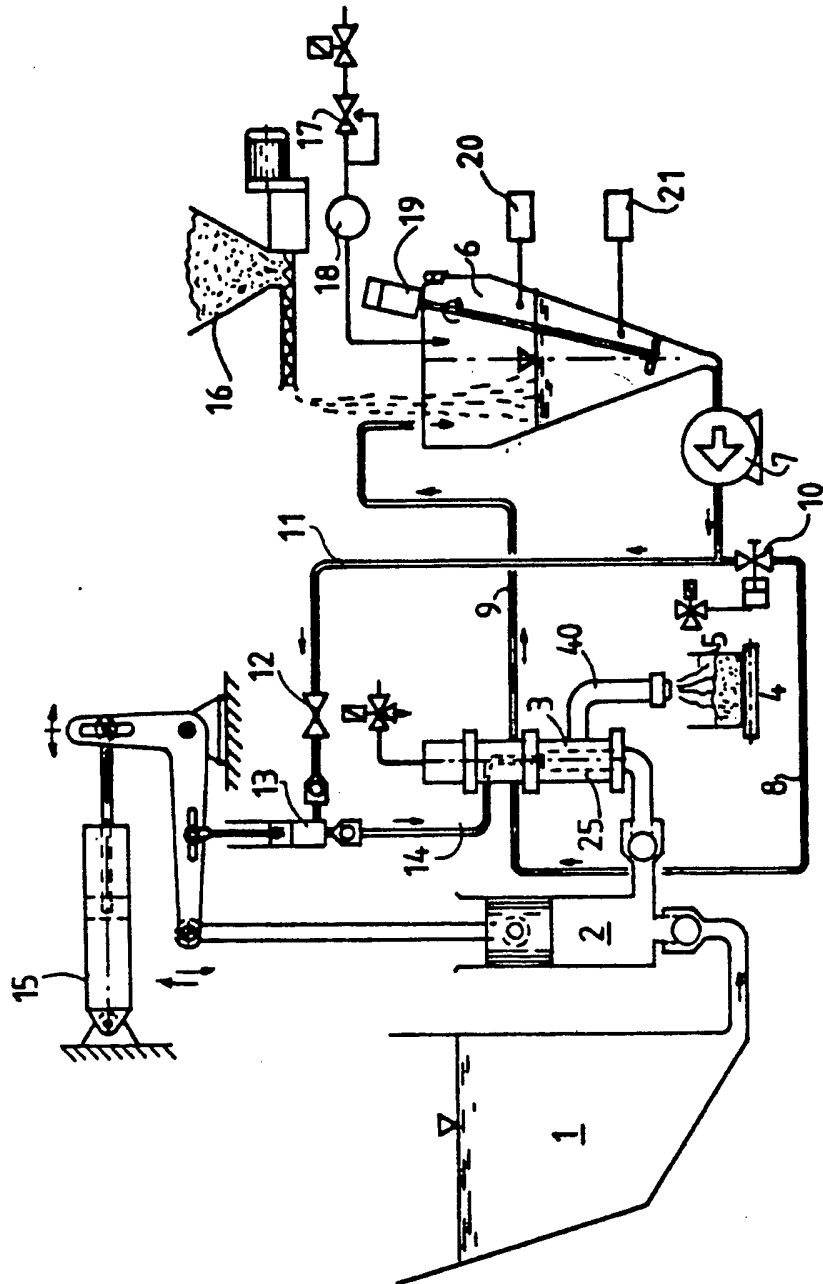


Fig.1

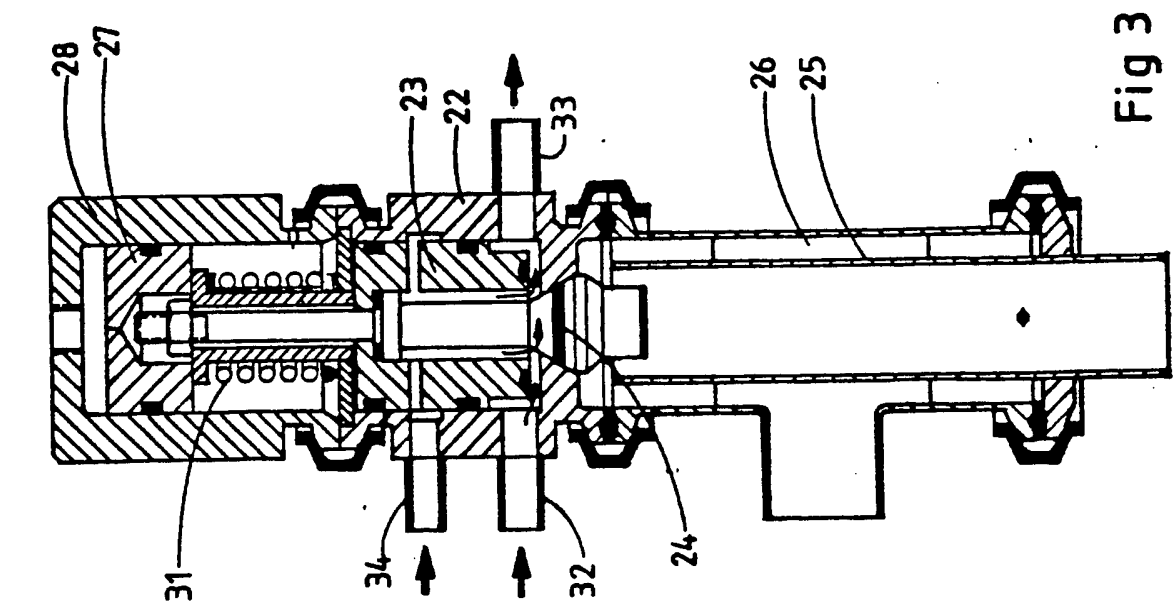


Fig. 3

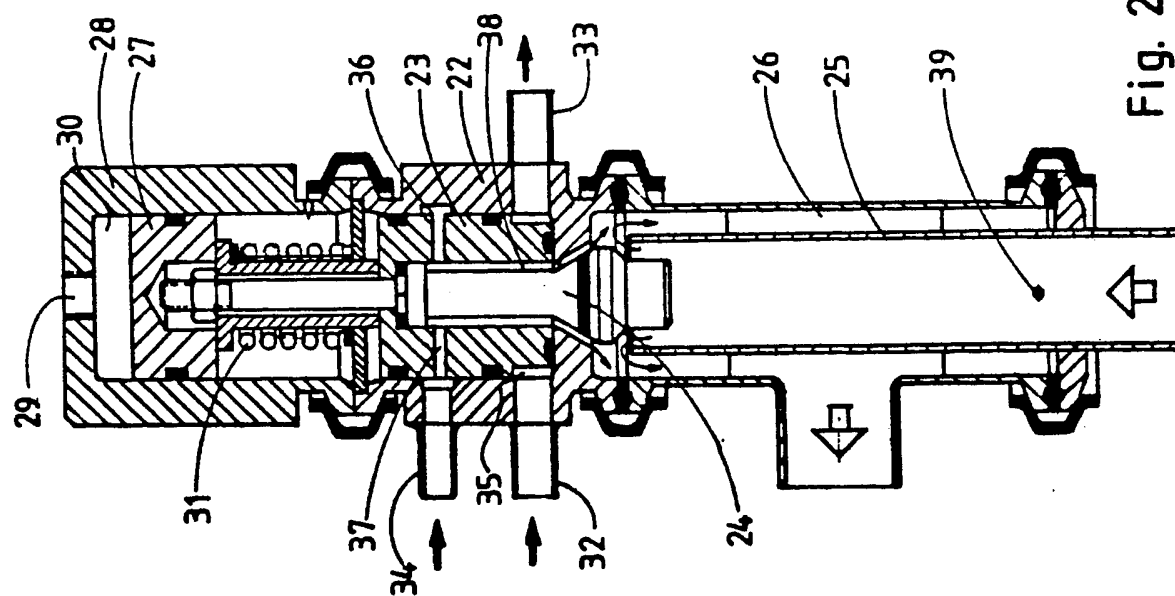


Fig. 2

# INTERNATIONAL SEARCH REPORT

International Application No PCT/SE87/00280

<b>I. CLASSIFICATION F SUBJECT MATTER</b> (if several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC 4		
A 23 C 20/02, A 01 J 25/00, B 01 F 3/08		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched ?		
Classification System	Classification Symbols	
IPC	A 01 J 25/00; A 23 C 20/00, /02; B 01 F 3/08	
US Cl	99:452; 137:3, 393, 564.5	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *		
SE, NO, DK, FI classes as above		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT*</b>		
Category *	Citation of Document, ** with indication, where appropriate, of the relevant passages 12	Relevant to Claim No. 13
X	GB, A, 2 027 603 (G A PLATON LIMITED) 27 February 1980 See claims 1-4 and the figure	1
X	DE, A1, 2 616 024 (HOECHST AG) 27 October 1977 See claim 8 and the figure & NL, 7703906 BE, 853486 FR, 2347967 GB, 1515103 AT, 354409 CH, 617102	1
X	US, A, 1 977 171 (S D CLITHERO ET AL) 16 October 1934 See claim 7 and fig 4	1
X	US, A, 3 779 261 (A E ZYGIEL) 18 December 1973 See claim 1 and the figures & US, E, 30301	1
<p>* Special categories of cited documents: 10</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"A" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
1987-08-25	1987-08-31	
International Searching Authority	Signature of Authorized Officer	
Swedish Patent Office	Inga-Karin Petersson	